

9-1579

25X1

TECHNICAL PROPOSAL

for a

FEASIBILITY STUDY

for

.5X and .25X OBJECTIVE LENSES

for the

25X1

ADVANCED STEREO RHOMBROID

Prepared by:

25X1

February 1970

NGA Review Complete

9-1579

25X1

.5X and .25X OBJECTIVE LENSES

for the

ADVANCED STEREO RHOMBOID

1.0 INTRODUCTION

The [] Advanced Stereo Rhomboid has three pairs of interchangeable objective lenses providing system magnifications of 1X, 2X and 3X. When installed on a Zoom 240 (or Zoom 70) Stereoscope Pod, the total magnification range with 10X eyepieces is 7X to 90X and the field of view varies from 28mm to 2.2mm. (See Table 1) To allow the operator to obtain a larger field of view, [] proposes to study the feasibility of developing lower power objective lenses. The system magnifications desired are .5X and .25X with 56mm and 112mm fields of view, respectively, at the lower zoom magnification. See Table 1.

The Advanced Stereo Rhomboid contains a 1.5X relay lens. However the objective lenses are "named" 1X, 2X and 3X, which are actually the system magnifications and are the product of the relay lens magnification times the objective lens magnification. The actual objective lens magnifications are .67X, 1.33X and 2X, respectively. See Figure 1, Optical Schematic. The actual objective magnifications required

OBJECTIVE LENS MAGNIFICATIONS
AND FIELDS OF VIEW

OBJECTIVE	MAGNIFICATION RANGE WITH POD & 10X EYEPIECES	FIELD OF VIEW WITH 10X EYEPIECES	MAGNIFICATION WITHOUT 1.5X RELAY
3X	21X - 90X	9.3mm - 2.2mm	2X
2X	14X - 60X	14mm - 3.3mm	1.33X
1X	7X - 30X	28mm - 6.5mm	.67X
.5X	3.5X - 15X	56mm - 13mm	.33X
.25X	1.75X - 7.5X	112mm - 26mm	.167X

TABLE 1

to obtain system magnification of .25X and .5X are, respectively, .167X and .33X. See Table 1.

2.0 DESIGN CONSIDERATIONS

The lower power objectives must be essentially similar physically to the present objectives. They must fit on the arms in the same manner, they should not raise the eyepoint, and the distance from the axis of rotation to the center of the field of view should be the same as with the present objectives. They should not interfere with the movement of the scanning operation of the light table. The desirable field of view is as given in Table 1.

3.0 DESIGN PROBLEMS

The problems to be encountered will be primarily a result of fitting the lenses into the envelope of the present lenses. The present lenses were designed using the technique of changing the location of the principal planes between lenses of different magnifications while keeping the lens elements, object and image plane in approximately the same location. (A lens of this type is known as a "telephoto" or "reverse telephoto"). It does not appear possible to use this technique for the lower power objectives. An alternative is to make the distance from the lens to the object plane longer. This can possibly be accomplished in the same overall space by folding the system with mirrors.

4.0 POSSIBLE DESIGNS

Following are several design configurations that might be explored as a solution to the design problems described above.

- a. Telephoto Lens. (Similar to present objective lenses.)
- b. Mirror system folding the optical path. (See Figure 2)
- c. Arm looking through itself. (See Figure 3)
- d. Addition of an intermediate image plane and relay in the arm. (See Figure 4)

These, and others, will be examined in greater detail during the feasibility study.

5.0 PRELIMINARY STUDIES

A preliminary study has been made of the configuration shown as Item 'b' in Section 4. The results are shown in Figures 5 and 6. The lenses have the same eyepoint and arm length as the present lenses. Enough analysis has been completed to indicate that it appears possible to remove detrimental residual aberrations.

6.0 STATEMENT OF WORK

Upon Receipt of a fully executed contract,

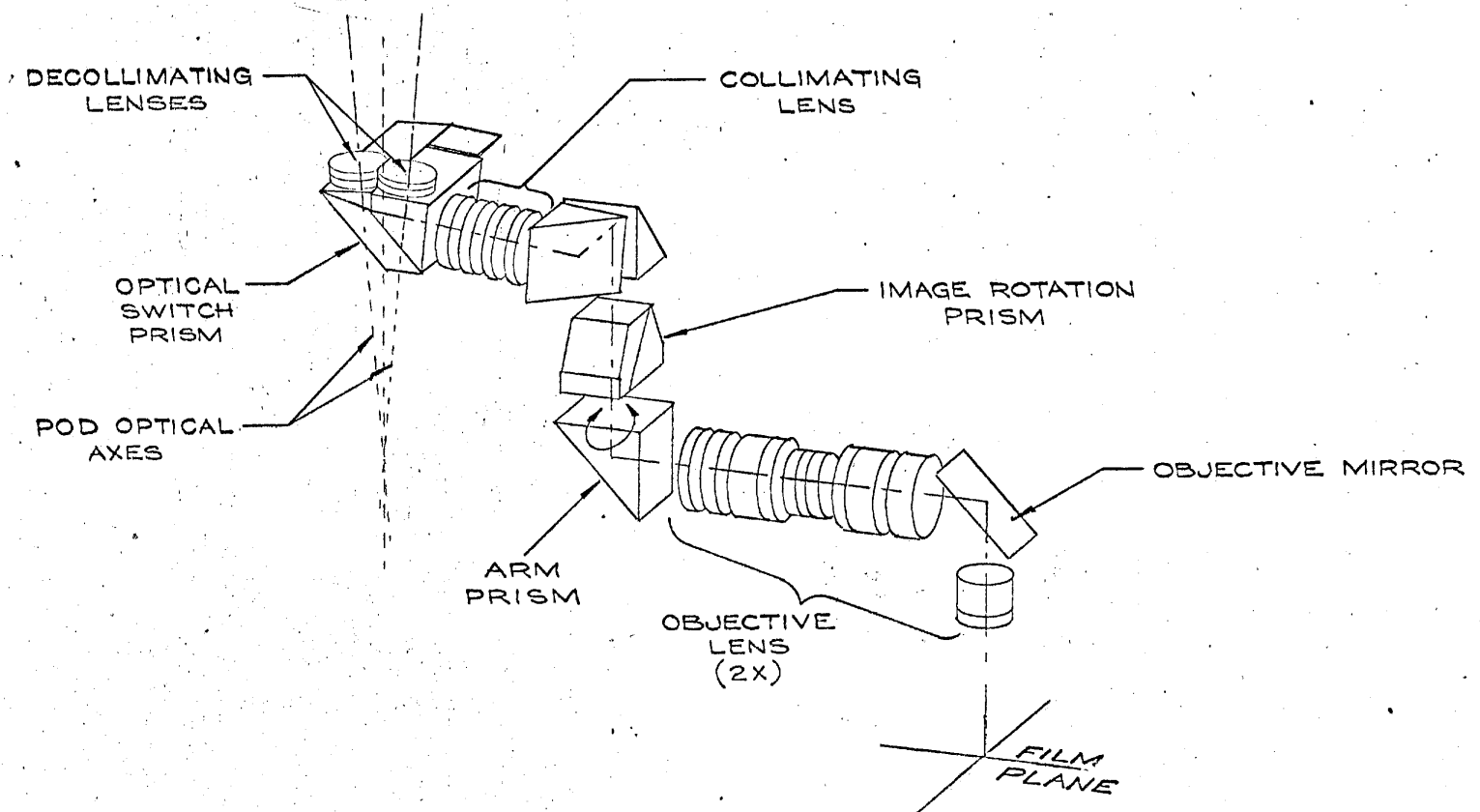
25X1

will accomplish the following:

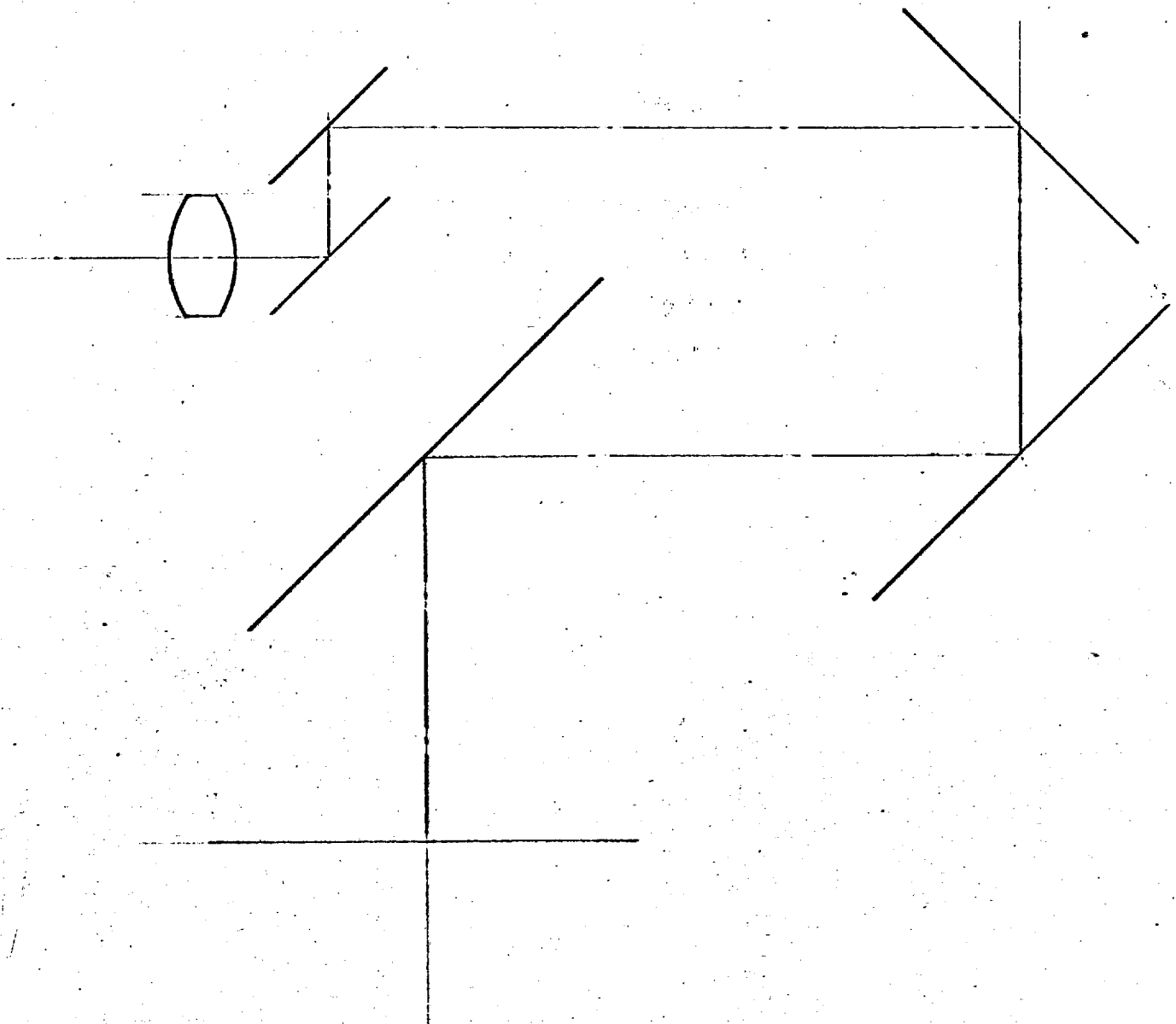
- a. Confer with the customer to critique the preliminary studies described in Section 5.

-4-

- b. Make preliminary system studies of a number of possible configurations, including those listed in Section 4.
- c. Assuming a feasible solution is found, the most promising configuration will be pursued to complete the preliminary optical design. Enough mechanical design will be performed to ensure that the mechanical-optical configuration is compatible with envelope restriction.
- d. Prepare a final report containing the preliminary design data and describing the recommended system.
- e. Prepare a cost estimate to complete the design and fabricate prototype lenses.
- f. Monthly progress reports will be prepared and submitted.

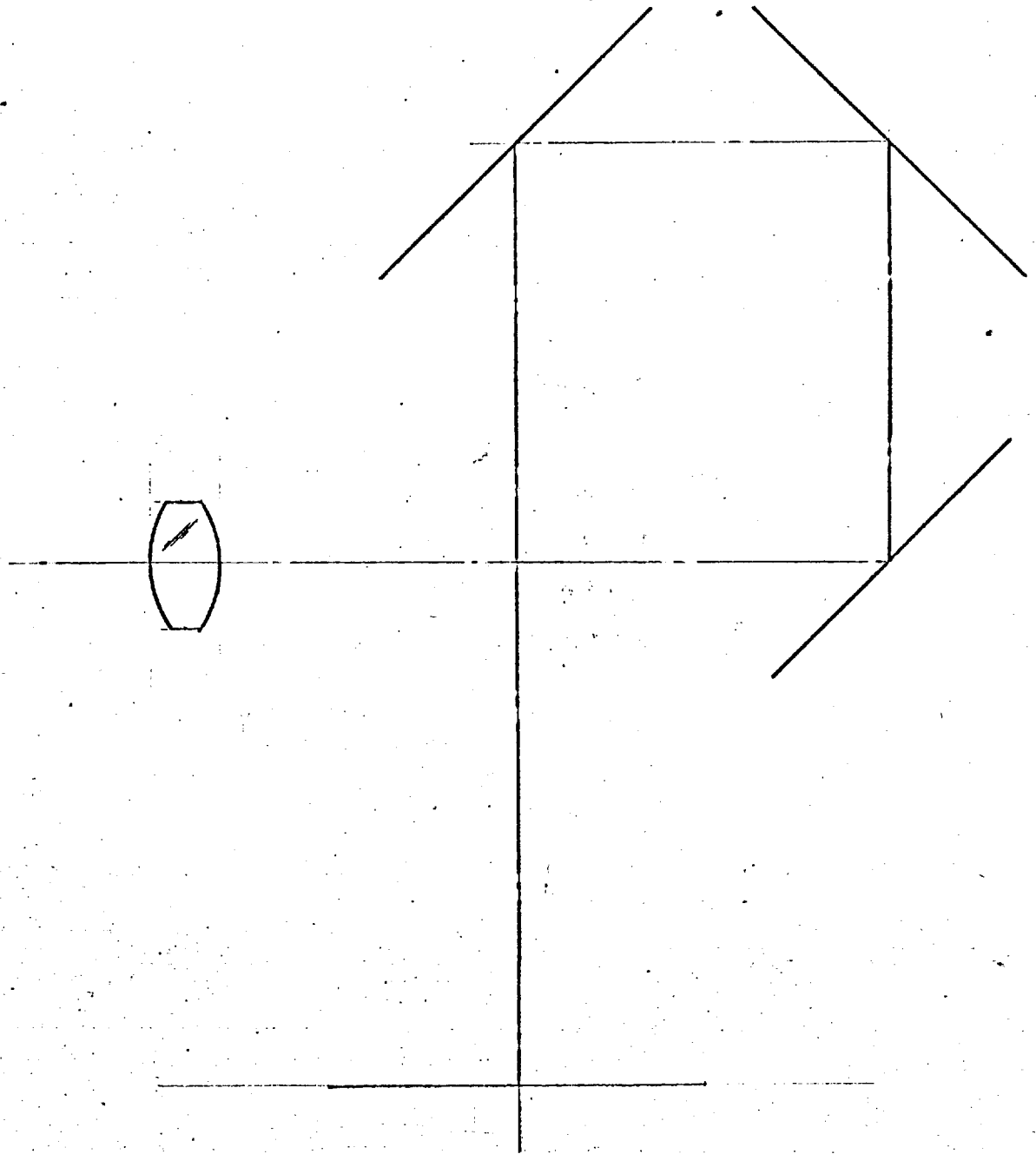


ADVANCED STEREO RHOMBOID
OPTICAL SCHEMATIC



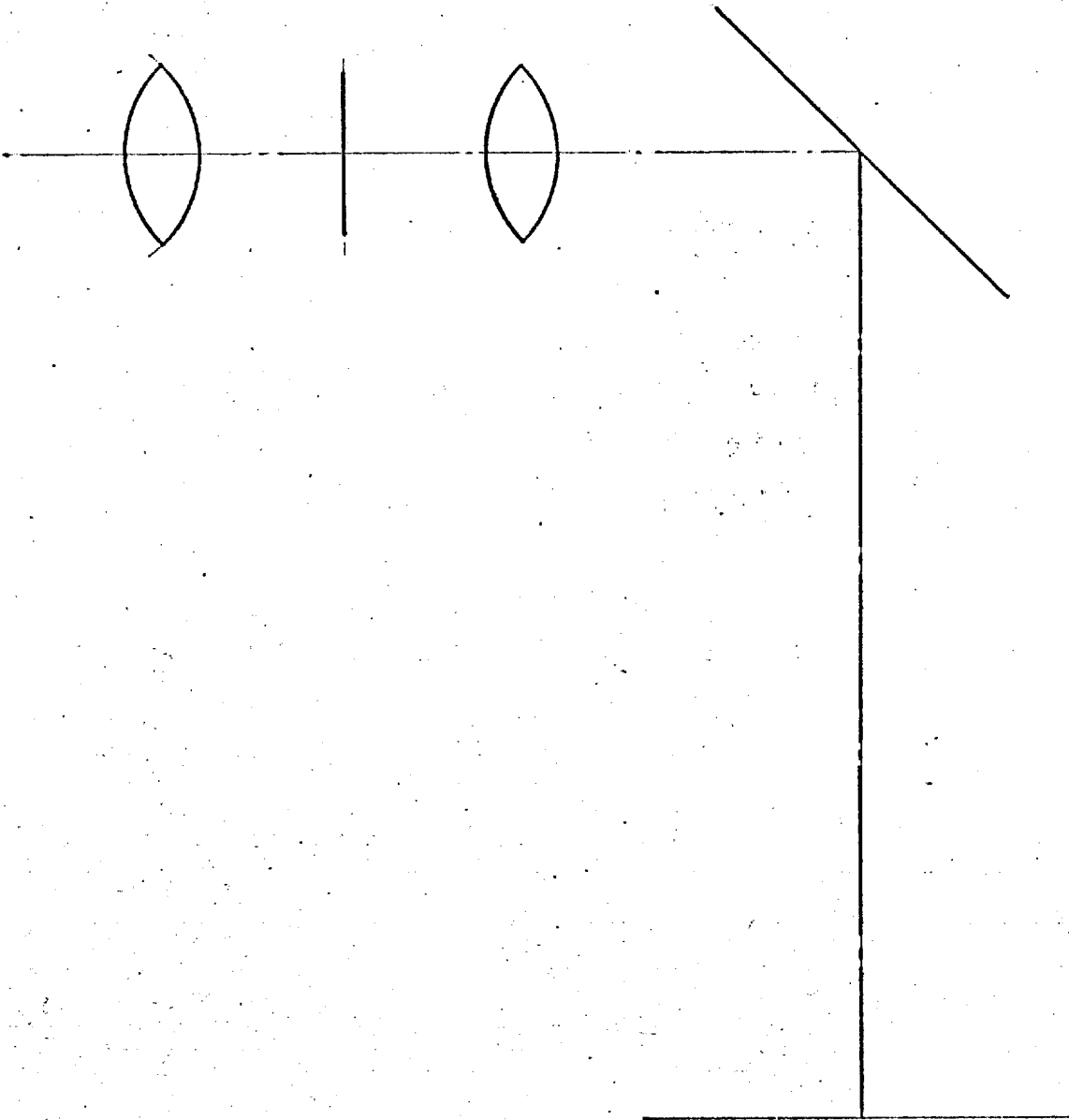
FOLDED OPTICAL SYSTEM

Figure 2



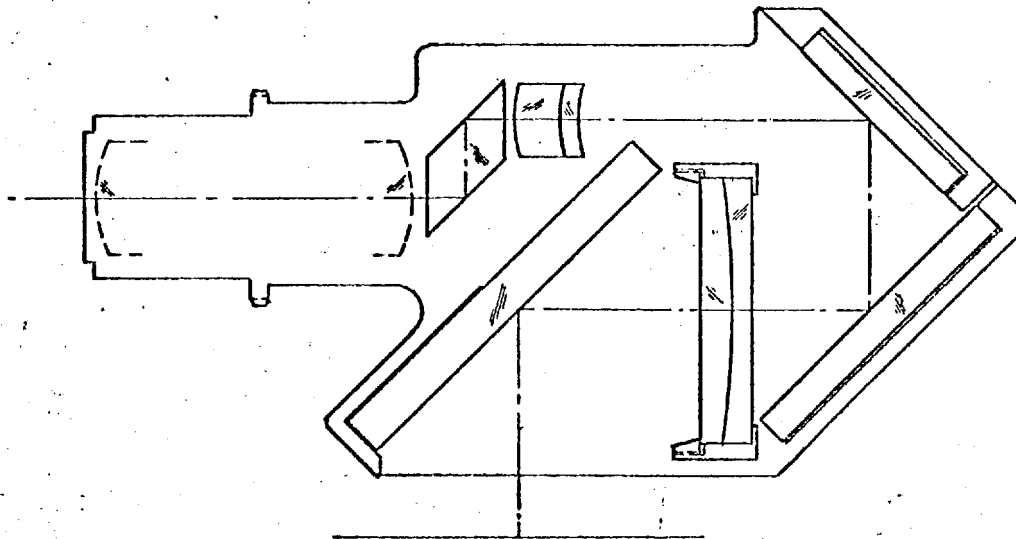
ARM LOOKING THROUGH ITSELF

Figure 3



ADDITIONAL INTERMEDIATE IMAGE PLANE

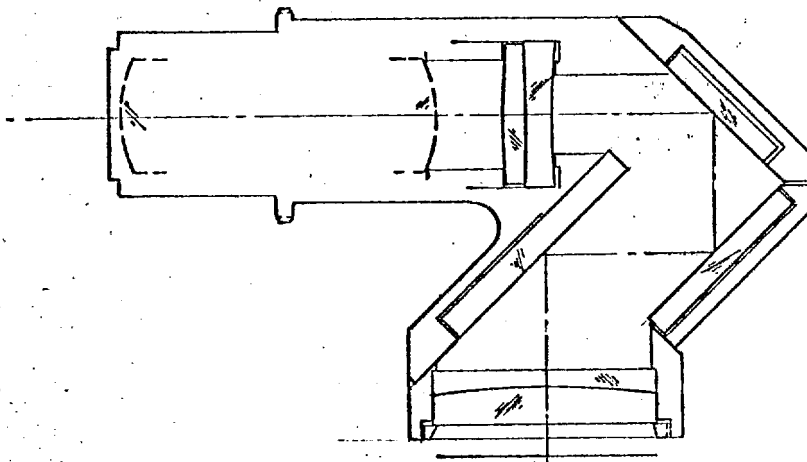
Figure 4



PRELIMINARY CONCEPT
.25X OBJECTIVE

Scale: 1/2 Size
2/4/70

Figure 5



PRELIMINARY CONCEPT
.5X OBJECTIVE

Scale: 1/2 Size
2/4/70

Figure 6